Decarbonizing Hard-to-Abate Sectors: How Green Hydrogen is Transforming Indian Industry?

At a time when industries grapple with the dual challenges of climate change and volatile fossil fuel markets, the quest for a scalable, secure, and clean energy alternative has intensified. For India, a nation witnessing exponential industrial expansion and rapid urbanization, decarbonization is no longer just an environmental obligation, it has now become a core economic imperative.

With a definitive goal to achieve Net-Zero emissions by 2070, India is positioning itself at the vanguard of the clean energy revolution. At the heart of

this transition lies **Green Hydrogen**, a clean energy carrier that holds the potential to completely rewrite India's macroeconomic narrative.

As a premier industry advocate, the PHD Chamber of Commerce and Industry (PHDCCI) recognizes that fostering a robust green hydrogen ecosystem is essential to building an *Aatmanirbhar* (self-reliant) energy economy. This comprehensive analysis delves into the technical, economic, and regulatory dimensions of Green Hydrogen, mapping out how India can transition from an energy-importing nation into a global green energy powerhouse.

The National Green Hydrogen Mission (NGHM): India's Blueprint for Leadership

To translate environmental intent into structured industrial growth, the Government of India launched the **National Green Hydrogen Mission** (NGHM). Backed by an initial financial outlay of ₹19,744 crore, the mission provides a comprehensive framework to establish a domestic hydrogen ecosystem.

According to official metrics available on the National Green Hydrogen Mission Portal of India, the mission focuses on three core pillars:

1. **Demand Creation:** Encouraging domestic adoption while establishing export channels to make Indian-produced hydrogen highly competitive.
2. **Supply-side Interventions:** Launching targeted fiscal incentive frameworks to support indigenous technology production.
3. **Ecosystem Building:** Developing standardizations, infrastructure, and a skilled workforce to facilitate rapid industrial scaling.

Macro Targets for 2030

The financial and operational blueprint of the NGHM targets major milestones by the end of this decade:

- **Production Capacity:** Achieving at least 5 Million Metric Tonnes (MMT) of Green Hydrogen per annum.
- **Renewable Energy Influx:** Integrating an associated renewable energy capacity addition of approximately 125 GW across the national grid.

- **Capital Outflow & Job Creation:** Attracting over ₹8 lakh crore in total investments and generating more than 6,00,000 green jobs throughout the value chain.
- **Carbon Abatement:** Averting nearly 50 MMT of annual greenhouse gas emissions.
- **Economic Security:** Slashing fossil fuel imports by over ₹1 lakh crore (€11.4 billion), directly insulating the domestic economy from geopolitical shocks.

The Economics of Green Hydrogen: Navigating the Journey to Cost Parity

The primary obstacle preventing green hydrogen from immediately replacing fossil fuels is production cost. Historically, green hydrogen has hovered around $4.50 (₹401.6) per kg, largely due to the high capital expense of electrolyzers and the cost of dedicated renewable energy transmission.

However, India's unique geographical position, declining solar tariffs, and targeted policy frameworks are driving these costs down. As highlighted by former NITI Aayog CEO Amitabh Kant during the National Green Economy Conclave, India aims to become the world's lowest-cost producer of green hydrogen by dropping prices to $1 (₹89.24) per kg by 2030. Reaching this critical price point will unlock an estimated $1.4 trillion market and completely transform India's manufacturing competitiveness.

The SIGHT Program: Accelerating Cost Reductions

To bridge the initial price gap, the Ministry of New and Renewable Energy (MNRE) implemented the **Strategic Interventions for Green Hydrogen Transition (SIGHT)** program. Substantial progress has been achieved through these financial incentive models:

· **Electrolyser Manufacturing Component:** Financial incentives totaling **₹4,440 crores** have been awarded to 15 companies, securing a domestic manufacturing capacity of **3,000 MW per annum**.

· **Green Hydrogen Production Component:** Cumulative production incentives have been granted to 18 companies to develop a capacity of **8,62,000 tonnes per annum**.

· **Grid Interconnection Ease:** Plants commissioned on or before December 31, 2030, are granted an absolute exemption from **Inter-State Transmission System (ISTS) charges** for a period of 25 years.

Sectoral Matrix: Transforming India's Hard-to-Abate Industries

For a diversified economy like India, green hydrogen is not a one-size-fits-all solution. It acts as a specialized tool to decarbonize "hard-to-abate" industries where direct electrification using batteries or solar grids is technically or economically unviable.

A. Fertilizers and Chemical Manufacturing

The agricultural sector depends heavily on chemical fertilizers, which currently use grey ammonia produced from imported natural gas. Transitioning to **Green Ammonia**, created by combining green hydrogen with atmospheric nitrogen-protects the agricultural sector from import fluctuations. Recognizing this potential, the MNRE scaled up its initial allocation under SIGHT Component-II, expanding green ammonia production targets to **7,50,000 tonnes per annum** to satisfy domestic fertilizer demands.

B. Iron and Steel Industry

Traditional steelmaking relies on coking coal in blast furnaces, making it a primary contributor to industrial carbon emissions. Green hydrogen can replace coal as a reducing agent, yielding Green Steel. This process emits only water vapor instead of carbon dioxide, keeping Indian steel exports competitive in international markets that enforce strict carbon taxes, such as the European Union's Carbon Border Adjustment Mechanism (CBAM).

C. Refineries and Petrochemicals

Petroleum refineries consume massive volumes of hydrogen for desulfurization and hydrocracking. Shifting to green hydrogen within existing refinery complexes allows the oil and gas sector to significantly lower its internal carbon footprint without requiring a complete redesign of downstream infrastructure.

D. Heavy-Duty Long-Haul Mobility

While battery electric vehicles (EVs) excel in passenger car segments, they face challenges in heavy-duty shipping, aviation, and long-haul commercial trucking

due to weight constraints and charging times. Hydrogen fuel cell vehicles (FCEVs) offer high energy density, long operational ranges, and fast refueling times, making them an excellent clean option for commercial logistics.

PHDCCI's Strategic Recommendations for an Agile Policy Framework

A capital-intensive sector like green hydrogen requires a supportive and flexible regulatory ecosystem. To accelerate implementation and encourage private investment, **PHDCCI** presented ten actionable policy recommendations to the Government of India during the 3rd International Climate Summit.

These proposals aim to remove regulatory bottlenecks, lower project risks, and improve ease of doing business across the clean energy sector. The core recommendations include:

1. **Harmonized Infrastructure Classification:** Formally include green hydrogen and green ammonia projects within India's *Harmonized List of Infrastructure*, allowing developers to access long-term, low-interest institutional financing.
2. **Fiscal Optimization via Zero GST:** Implement a **0% Goods and Services Tax (GST)** rate for green hydrogen, green ammonia, and related equipment to lower project costs during the early phases of deployment.
3. **Customs Duty Waivers:** Waive basic customs duties on imported high-efficiency electrolyzers and specialized components until 2030 to prevent supply chain bottlenecks while domestic production scales up.
4. **Extension of Corporate Tax Incentives:** Extend the lower tax benefits under *Section 115BAB* for green hydrogen manufacturing units until December 31, 2030, providing a predictable tax structure for international investors.
5. **Carbon Credit Trading Integration:** Explicitly recognize clean hydrogen derivatives like green methanol and Sustainable Aviation Fuel (SAF) as eligible activities for international carbon credit trading systems.
6. **Special Economic Zone (SEZ) Reforms:** Amend SEZ rules to allow manufacturing units to process green hydrogen and its derivatives more efficiently, reducing operating overheads and boosting export potential.

7. **Relaxed SEZ Rules for Co-located Renewable Energy Plants:** Provide regulatory flexibility to off-site renewable energy plants supplying green electricity directly to hydrogen manufacturing units within SEZs.
8. **Streamlined Land and Infrastructure Allocation:** Establish fast-track single-window clearances for land acquisition near major ports and industrial clusters, offering annuity-based payment models to lower upfront capital requirements.
9. **Removal of Additional State-Level Power Charges:** Encourage state governments to eliminate additional charges, cross-subsidy surcharges, and state-level duties on cross-border transmission of solar and wind power intended for green hydrogen production.
10. **Establishment of Centers of Excellence (CoE):** Set up specialized technical training institutions and dedicated testing facilities for electrolyzers and high-pressure storage tanks to ensure domestic manufacturing meets international safety standards.

Addressing Structural Barriers

While the long-term outlook for green hydrogen is promising, building a mature hydrogen economy requires addressing several near-term technical and logistical challenges:

- **Volumetric Energy Density:** Hydrogen has high energy density by weight but low density by volume. Storage and long-distance transportation require either high-pressure compression (350 to 700 bar) or cryogenic liquefaction (-253 degree Celsius), both of which are highly energy-intensive.
- **Infrastructure Investment:** Building dedicated pipeline networks, specialized maritime shipping terminals, and localized distribution hubs requires significant upfront capital.
- **Water Resources:** Producing 1 kg of green hydrogen requires roughly 9 kilograms of highly purified water. To avoid depleting local groundwater resources, production hubs should ideally be located near coastal regions where desalinated seawater can be utilized sustainably.

By focusing early investments on localized **Green Hydrogen Hubs-** where production and industrial consumption are co-located-India can minimize storage and transport costs while the national pipeline network develops.

Conclusion: Driving India's Sustainable Industrial Future

Green hydrogen is more than an alternative fuel; it serves as a foundation for sustainable, long-term industrial growth. By linking India's abundant renewable energy resources with its deep industrial manufacturing base, green hydrogen provides a practical path toward energy security, deep decarbonization, and high-value job creation.

Achieving these goals requires close collaboration between government agencies, private enterprises, and industry bodies. **PHDCCI** remains fully committed to supporting this transition- facilitating policy discussions, promoting international technology partnerships, and helping build an industrial ecosystem capable of leading the global green economy. Through targeted investments, clear policy frameworks, and sustained industry execution, India is well-positioned to turn its net-zero goals into a strong foundation for long-term economic prosperity.

https://www.phdcci.in/centre-of-excellence-in-green-hydrogen/